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(54) APPARATUS FOR DETECTING THE THICKNESS OF SHEETS.

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Description

This invention relates to an apparatus for detecting the passage of superimposed sheets as they are moved through the apparatus, and is especially applicable to the delivery of branknotes where the thickness of two or more superimposed banknotes should be distinguished from that of a single banknote.

Machines for detecting the simultaneous passage of two banknotes where banknotes should normally pass singly are known, and one example of an optical detector is in GB—A—1344986, the detector responding to the opacity of the note or notes; this is inadequate if the notes are greasy or soiled. Mechanical thickness detectors are also known using a roller whose axis is displaced by the passage of a banknote or banknotes to cause an electrical contact to be made or broken if the displacement is such as to indicate the passage of superimposed banknotes. Apparatus for gauging laminar materials, using nip rollers and a variable-reluctance transducer, is disclosed in GB—A—1497181, from which the preamble of present Claim 1 is derived.

A source of error in such detectors is long-term variation in the detecting heads or in the control circuits which tends to change a preset threshold value of the banknote thickness which, when exceeded, results in the detector signaling the passage of superimposed banknotes. In the case of the mechanical detector using a roller, this long-term variation could be caused by mechanical movement between the pivot of an arm attached to the axis of the roller, and the surface on which the note is placed as it is moved under the roller. This potentially degrades note thickness measurement if the output of the detector is compared against a fixed threshold level in the output stages of the control circuit. Mechanical stability of the order required for measuring banknote thickness, for example 0.005 cm to 0.015 cm, is difficult to achieve under reasonable manufacturing and wear rate conditions.

The above-mentioned opacity-responsive detector disclosed in GB—A—1344986 provides a measure of compensation for such long-term variation. The apparatus disclosed in this specification has an RC circuit for storing on a capacitor the peak value of the signal which is obtained from the detector in the absence of a note under the detector, as well as a potentiometer which is connected across the capacitor and by means of which a proportion of the capacity voltage is tapped to serve as a threshold voltage for comparison with the existing detector output; this circuit serves to detect the passage of a single note and a second similar circuit is provided for the recognition of the passage of two or more superimposed notes, the potentiometer of the second circuit providing a threshold voltage of a different value.

Such a compensating circuit assumes that the thresholds of detection for the single and superimposed notes will vary in proportion to variation of the no-note signal level (or no-sheet reference level).

Apparatus according to the present invention enables the reference differential for single and multiple notes to be maintained, irrespective of changes in the no-sheet reference level.

Apparatus according to the invention for detecting the passage of single and multiple sheets along a flow path comprises: a surface in the flow path for supporting the sheet or sheets; a follower biased such that it normally abuts against the supporting surface and follows the profile of the supporting surface and the overlying sheet or sheets; a transducer responsive to the position of the follower to provide a thickness signal indicative of the linear displacement of the follower relative to the supporting surface due to the passage of the sheet or sheets; and a control circuit which compares the thickness signal with at least one stored threshold level signal to provide an output signal indicative of whether the detected thickness corresponds to that of a single sheet or multiple sheets; and is characterized in that the control circuit includes means responsive to the said thickness signal for repeatedly updating a stored no-sheet reference level in the absence of a sheet, and adjustable threshold level generating means including adjustable means for generating first and second signals which correspond to changes in the output of the transducer in response to the passage of a single sheet and two superimposed sheets, respectively, and means connecting the first and second signal generating means to the output of the updating means to add the updated no-sheet reference level to the first and second signals to obtain updated first and second threshold level signals which will be exceeded by the output of the transducer in response to the passage of a single and two superimposed sheets, respectively.

Preferably, a pivoted arm conveys the movement of the follower to a transdcuer in the form of a linear variable differential transformer.

An alternative apparatus comprisea a follower which is a cylindrical roller, the transducer being of the variable reluctance type and comprising a transformer whose magnetic circuit is completed by a portion of the periphery of the said follower, the thickness signal being the voltage across the transformer which depends on the degree of displacement of the follower roller towards a core of the transformer.

In order that the invention may be better understood, two embodiments of the invention will now be described with reference to the accompanying drawings, in which:—

Figure 1 illustrates diagrammatically an apparatus for detecting the passage of single and multiple sheets and an associated control circuit according to a first embodiment of the invention;

Figure 2 shows the transducer of Figure 1 in greater detail;

Figures 3A and 3B, which are halves of the same circuit diagram, show the control circuit in greater detail;

Figure 4 is a waveform diagram for signal TP3 of Figure 3; and

Figure 5 illustrates an apparatus according to a second embodiment of the invention.

Referring first to Figure 1, a banknote 5 is moved by a conveyor 6, whose surface also serves as a reference datum, into the nip formed between a cylindrical roller 1 and the conveyor surface. The roller 1 is attached at its axle to a pivot arm 2 which is biased in the anticlockwise direction but is free to rotate about a pivot 3. A linear transducer constituted by a linear variable differential transformer (L.V.D.T.) 4 has a movable core attached to the other end of the pivot arm and is energised by the oscillator 7. The downward displacement of the core when the roller is pushed up by the passage of the banknote under the roller is proportional to the thickness of the banknote, and the resulting change in the output of the transformer is detected by the level detector 8. A signal having an amplitude corresponding to the thickness of the banknote is fed by the level detector 8 to an auto-reference circuit 9. An alternative to this arrangement would be to dispense with the pivot arm 2 and to drive the L.V.D.T. core directly, e.g. by a jockey wheel.

The expected thickness of a banknote is set manually by a control 11 for a thickness control circuit 10. The thickness control circuit 10, in combination with the auto-reference circuit 9, derives a threshold level for a single banknote, by adding the expected thickness to a reference datum level controlled by the level detector 8. The thickness control circuit 10, in combination with the auto-reference circuit 9, also provides the threshold level for superimposed banknotes. During operation of the apparatus, the auto-reference circuit repeatedly updates these threshold level values when there is no banknote under the roller, to take into account changes in the datum level.

When one or more banknotes pass under the roller, the level detector 8 provides a thickness signal which is compared in the comparators 12 and 13 with the threshold levels, which in turn provide output signals 14 and 15 according to the results of the comparisons.

The thickness control 11 can be manually adjusted by an operator, for example when changing from feeding British banknotes to French banknotes which are notably thinner than the British notes.

Referring to Figure 2, the end of the pivot arm 2 which engages with the L.V.D.T. 4 is attached by a short rod to a core 24, which is free to move axially within the L.V.D.T. Movements of the roller 1 are converted by the pivot arm into larger, antiparallel movements of the core 24, and the axial position of the core determines the magnitude of the signal provided by the L.V.D.T. to the level detector 8.

The L.V.D.T. 4 is symmetrical about a central plane C—C normal to the axis and the upper half (in Figure 2) is not used. With the roller 1 touching the surface 6, with no note present, the core 24 should be at a position Q—Q, a little displaced from the central plane. This is known as the quiescent start point. The L.V.D.T. provides a zero output with the core 24 at the central plane C—C, but provides signals of increasing magnitude as the core is moved away from this plane (in either direction). With a single note thickness between the roller 1 and the surface 6, the core 24 reaches a plane S—S, and with a double thickness it reaches a plane D—D. In use, atmospheric variations and general wear may cause these positions and the quiescent start point to drift in either direction, it being the purpose of the auto-reference circuit to compensate for this drift. The acceptable limit of drift in one direction for the quiescent start point Q—Q is the central plane C—C; the region of drift in this direction is the lower drift area LDA. The acceptable limit of drift in the opposite direction of the double thickness plane D—D is the end of the transformer coil, beyond which there is no longer a linear relationship between the core position and the output signal; the region of drift in this opposite direction is the upper drift area UDA.

For the system to cope with the maximum range of mechanical drift, the sensor core must be positioned at the optimum quiescent start point within the sensor body when the system is fitted to a machine.

The quiescent start point can easily be set by adjusting the sensor body to give a reference voltage output from the level detector 8 to the auto-reference circuit 9 of 0.5 V D.C.

There are, however, two such positions, corresponding to reflections of the core position about the central plane C—C, or sensor zero-output point. The correct one can be found by moving the core 24 in the direction of increasing banknote thickness and checking that the voltage output also increases. With the L.V.D.T. and core correctly adjusted, the voltage output from the level detector 8 is the 0.5 volt reference value with no note present, and, for exampe, 0.8 V with a single note and 1.1 V with two superimposed notes. These values will be referred to as TP3, TP1 and TP2 respectively. A convenient way of adjusting the L.V.D.T. to give an output of 0.5 V with no note present is by means of a voltage monitoring circuit, as shown at the bottom of Figure 3B. The voltage signal TP is fed into the monitoring circuit, which lights either a red light-emitting diode LED 1 or a green light-emitting diode LED 2 depending on whether the voltage TP3 is outside or inside acceptable voltage tolerances around the nominal 0.5 volt level. A voltage divider network of resistor RR1 (e.g. 5600 ohms), RR2 (e.g. 220 ohms) and RR3 (e.g. 560 ohms) connected between a 5-volt reference level and ground provides a voltage slightly above 0.5 V to a first comparator CC1, and a voltage slightly below 0.5 V to a second comparator CC2. The signal TP is fed to the other input terminal of each comparator, and the outputs of the comparators are added to produce a signal which is at one level if the signal TP is between the voltages supplied to the comparators CC1 and CC2 by the

voltage divider network, and another level if the signal TP is not between these voltages. This signal is fed to a pair of series-connected pnp and npn transistors, so connected that either LED 1 or LED 2 is illuminated depending on the signal value. With no note present, the L.V.D.T. core is moved relative to the transformer until the green diode LED 2 comes on.

Figures 3A and 3B are two halves of the circuit diagram of this preferred embodiment of the invention.

The L.V.D.T. 4 is driven by a primary drive oscillator 7 including an amplifier IC3/1 which runs at about 10 kHz. The oscillator circuit 7 supplies an output through an electrolytic capacitor to the drive coil of the L.V.D.T. 4. The L.V.D.T. output is amplified about five times by amplifier IC3/2, and reaches diode D7 via a high-pass filter, which allows only the carrier content of the signal to pass through. Diode D6 provides D.C. restoration to gain full advantage of the envelope.

The signal emerging from diode D7 and a following series-connected resistor is labelled TP and is of the form shown in Figure 4, in which reference levels TP1 and TP2 are the threshold levels for the passage of a single note and of two superimposed notes, respectively, and reference level TP3 represents the no-note condition. This waveform has a first peak corresponding to a single note, a second peak corresponding to the passage of two superimposed notes, and a third peak similar to the first for another single note. The lowest level of signal TP, obtained when no note is present, is nominally 0.5 V, i.e. the reference level TP3. The peaks for the single and superimposed notes exceed their respective thresholds TP1 and TP2.

The output signal TP from the level detector 8 is fed to the auto-reference circuit 9, which is connected to circuits 12, 13 for determining the presence of a single note or superimposed notes. Signal TP is fed to an amplifier IC2/1 whose output normally follows the TP signal. However when a note appears, a transistor TR6 connected between the output of IC2/1 and the reference level, is switched off by a single-note comparator 12 which includes an amplifier IC2/3. The comparator 12, the operation of which will be described later, is connected to the base of transistor TR6 and prevents the output of IC2/1 from following the level of the output signal TP while a note is present.

The output level of IC2/1 is maintained by an electrolytic capacitor C13, connected between the output of IC2/1 and ground. This level is maintained by the capacitor C13 until the note has passed. A resistor network consisting of resistors R48, R50 and R51 ensures that the capacitor C13 always attempts to charge towards the optimum quiescent point to prevent any possible locking out of the system. The output level from the amplifier IC2/1 is also conveyed to an input of another amplifier IC2/2, shown in the upper half of Figure 3A. This part of the circuit is responsible for obtaining threshold level signals TP1 and TP2 from the reference defined by the potential stored in capacitor C13. The reference levels for single and superimposed notes are derived from the reference level TP3 obtained when no note is present. The purpose of this part of the circuit is to maintain the differences between the threshold level signals TP1 and TP2 and the reference level TP3 despite any variation in the reference level TP3, the difference being determined by a thickness control circuit 10 comprising a variable resistor RV1 (adjusted by control 11, Figure 1). An amplifier IC3/3 and a transistor TR8 are connected to form a constant current source, the current output of which is determined, in accordance with the desired threshold thickness level, by the setting of the variable resistor RV1 connected to the non-inverting input of the amplifier IC3/3. Reference resistors R49 and R52 are connected in series between the collector of transistor TR8 and the output of the amplifier IC2/2. The reference resistors R52 and R49 are fed by the constant current source TR8, IC3/3; the resistors together with the constant current source form a transconductance amplifier. The current passing through the reference resistors sets up the two threshold level signals TP1 and TP2 for a single note and two superimposed notes respectively. The threshold level signals are fixed above the output of amplifier IC2/2 which is effectively the TP3 "no note" reference level. Any change in the reference level TP3, therefore causes the threshold level signals TP1 and TP2 to change by the same amount, thus retaining the reference differentials. The values of the threshold level signals for single and double thicknesses of notes are therefore always set with reference to the current quiescent displacement of the core of the L.V.D.T. 4.

The threshold level signals TP1 and TP2 are conveyed to difference amplifiers IC2/3 and IC2/4 respectively, as shown in Figure 3B. Amplifiers IC2/3 and IC2/4 together with their respective feedback resistors constitute output comparators for single and superimposed notes respectively, designated 12 and 13 in Figure 1. The other input to the comparators in each case is the current value of the output TP from the level detector 8. The outputs 15, 14 of the output comparators 12, 13 are fed to transistors TR3 and TR4, the emitter of each transistor being connected to a reference potential. Transistors TR3 and TR4 are normally saturated switches. Transistor TR3 turns off when a single note is present, and TR4 turns off when superimposed notes are present. These transistors provide outputs at points 31 and 32 to further circuits (not shown) which may respond to the presence or absence of single or superimposed notes.

In the circuit shown in Figure 3A, reference resistors R49 and R52 need not have the same value, thus allowing the differentials between the threshold potential values to be different. The difference between TP2 and TP3 need not be exactly double that between TP1 and TP3.

The control circuit described above responds to the presence of single or double banknote thicknesses, but could be extended to respond to multiple banknote thicknesses, or to the thicknesses of different types of banknotes. The detector could for example discriminate between a thick note and a thin note and/or between double thicknesses of each type of note.

Apparatus according to a second embodiment of the invention is shown in Figure 5, which includes nip rollers and a variable reluctance transducer of the type disclosed in GB—A—1497181. The banknote 5 is fed into the nip of rollers 51 and 52. Roller 51 has an axle which is not free to move vertically, but follower roller 52 is free to move vertically in accordance with the thickness of the banknote. The follower roller is a rubber flexing roller which is eccentrically deformable and has a steel tyre which moves in the mouth of the magnetic core of a transducer transformer 53, causing the transducer reluctance to vary in accordance with the gap between the core and the tyre. A measurement of the reluctance therefore reveals the thickness of the banknote.

A coil L1 in the transformer is supplied with the current i from a current source 54, at a voltage Vs which constitutes the A.C. thickness signal provided to the level detector 8 of Figure 1. The voltage Vs is proportional to $2\pi fLI$, where $L = N^2/Rm$, L being the inductance of the coil, N being the number of turns, Rm being the reluctance; I being the amplitude and f being the frequency of the A.C. current $i = I \sin(2\pi ft)$.

This system offers maintenance-free operation since there are no mechanical linkages, and it is unaffected by dust. Also, because the signal is compatible with the control circuit above, mechanical tolerances and long-term drift such as wear or thermal expansion are coped with.

Claims

1. Apparatus for detecting the passage of single and multiple sheets along a flow path, comprising: a surface (6) in the flow path for supporting the sheet or sheets; a follower (1) biased such that it normally abuts against the supporting surface (6) and follows the profile of the supporting surface and the overlying sheet or sheets; a transducer (4, 53) responsive to the position of the follower to provide a thickness signal (TP) indicative of the linear displacement of the follower relative to the supporting surface due to the passage of the sheet or sheets; and a control circuit which compares the thickness signal (TP) with at least one stored threshold level signal (TP1, TP2) to provide an output signal (31, 32, 33) indicative of whether the detected thickness corresponds to that of a single sheet or multiple sheets; characterized in that the control circuit includes means (9) responsive to the said thickness signal (TP) for repeatedly updating a stored no-sheet reference level (TP3) in the absence of a sheet, and adjustable threshold level generating means including adjustable means (RV1, IC3/3, TR8, R49, R52) for generating first and second signals which correspond to changes in the output of the transducer in response to the passage of a single sheet and two superimposed sheets, respectively, and means connecting the first and second signal generating means to the output of the updating means (9) to add the updated no-sheet reference level to the first and second signals to obtain updated first and second threshold level signals which will be exceeded by the output of the transducer in response to the passage of a single and two superimposed sheets, respectively.

2. Apparatus in accordance with claim 1, wherein the means for generating the said first and second signals comprises a manually adjustable variable resistor (RV1), a constant current source (IC3/3, TR8) whose output is determined by the variable resistor, and first and second reference resistors (R49, R52) connected in series between the output of the constant current source and the output of the updating means (9).

3. Apparatus in accordance with claim 1 or 2, wherein the stored no-sheet reference level (TP3) is in the form of a D.C. voltage stored in a capacitor (C13), the apparatus including means (TR6) for preventing the capacitor from following the said thickness signal (TP) whenever the value of the thickness signal differs substantially from its value when there is no sheet between the supporting surface and the follower (1).

4. Apparatus in accordance with any preceding claim, wherein the follower (1) is attached to one end of an arm (2), and the transducer (4) engages the other end of the arm.

5. Apparatus in accordance with claim 4, including an elongate arm pivoted at a point (3) along its length for conveying the movement of the follower to the transducer.

6. Apparatus in accordance with claim 5, wherein the position of the pivot point along the arm is such that small displacements of the follower are converted into larger displacements of the other end of the arm engaging with the transducer.

7. Apparatus in accordance with claim 4, 5 or 6, wherein the follower is a cylindrical roller whose axle is attached to one end of the arm.

8. Apparatus in accordance with any preceding claim, wherein the transducer is a linear variable differential transformer.

9. Apparatus in accordance with claim 1, 2 or 3 wherein the follower (52) is a cylindrical roller, and the transducer (53) is of a variable-reluctance type comprising a transformer whose magnetic circuit is completed by a portion of the periphery of the follower (52), the thickness signal being the voltage (Vs) across the transformer and being dependent on the degree of displacement of the follower roller towards a core of the transformer.

10. Apparatus in accordance with claim 9, wherein the supporting surface for the sheet or sheets is a second roller (51), which together with the follower constitutes a nip for the sheet or sheets.

Patentansprüche

1. Vorrichtung zum Erfassen des Durchgangs von einfachen und mehrfachen Blättern längs einem Vorschubweg, mit einer Stützfläche (6) zum Abstützen des Blattes oder der Blätter am Vorschubweg, einem Abtaster (1), der so vorgespannt ist, daß er normalerweise an der Stützflache (6) anliegt und dem Profil der Stützfläche und des darauf befindlichen Blattes oder der Blätter folgt, einem Wandler (4, 53) der auf die jeweilige Lage des Abtasters anspricht und ein Dickensignal (TP) liefert, welches die lineare Verlagerung des Abtasters bezüglich der Stützfläche (6) infolge des Durchganges des Blattes oder der Blätter angibt, und einer Steuerschaltung, welche das Dickensignal (TP) mit wenigstens einem gespeicherten Schwellenwertsignal (TP1, TP2) vergleicht, um ein Ausgangssignal (31, 32, 33) zu liefern, welches anzeigt, ob die festgestellte Dicke jener eines einzelnen Blattes oder mehrerer Blätter entspricht, dadurch gekennzeichnet, daß die Steuerschaltung eine Einrichtung (9), welche auf das Dickensignal (TP) anspricht und wiederholt einen gespeicherten Kein-Blatt-Bezugspegel (TP3) bei Nichtvorhandensein eines Blattes nachstellt, und einstellbare Schwellenwert-Erzeuger enthält, die einstellbare Mittel (RV1, IC3/3, TR8, R49, R52), zur Erzeugung erster und zweiter Signale aufweisen, welche den Signaländerungen im Ausgang des Wandlers infolge des Durchganges eines einzelnen Blattes bzw. von zwei übereinanderliegenden Blättern entsprechen, sowie Mittel, welche diese ersten und zweiten Signalerzeuger mit den Ausgang der Nachstelleinrichtung (9) verbinden, um den nachgestellten Kein-Blatt-Bezugspegel zu den ersten und zweiten Signalen zu addieren und so nachgestellte erste und zweite Schwellenwerte zu erhalten, welche vom Ausgangssignal des Wandlers bei Durchgang eines einzelnen Blattes bzw. von zwei übereinanderliegenden Blättern übertroffen werden.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Mittel zur Erzeugung des ersten und zweiten Signals einen von Hand aus verstellbaren variablen Widerstand (RV1), eine Konstantstromquelle (IC3/3, TR8), deren Ausgang mittels des variablen Widerstandes einstellbar ist, und einen ersten und zweiten Bezugswiderstand (R49, R52) aufweisen, die seriengeschaltet zwischen dem Ausgang der Konstantstromquelle und dem Ausgang der Nachstelleinrichtung (9) liegen.

3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der gespeicherte Kein-Blatt-Bezugspegel (TP3) eine in einem Kondensator (C13) gespeicherte Gleichspannung ist und daß die Vorrichtung Mittel (TR6), enthält, welche verhindern, daß die Kondensatorspannung dem Dickensignal (TP) folgt, sobald der jeweilige Wert des Dickensignales wesentlich von jenem Wert abweicht, der sich ergibt, wenn sich zwischen der Stützfläche und dem Abtaster (1) kein Blatt befindet.

4. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß der Abtaster an einem Ende eines Armes (2) angebracht ist, während der Wandler (4) mit dem anderen Ende dieses Armes zusammenwirkt.

5. Vorrichtung nach Anspruch 4, gekennzeichnet durch einen langgestreckten Arm, der in einem Punkt (3) seiner Längserstreckung schwenkbar gelagert ist und die Bewegung des Abtasters auf den Wandler überträgt.

6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß die Lage des Lagerpunktes längs des Armes so gewählt ist, daß kleine Verlagerungen des Abtasters in größere Verlagerungen des anderen, mit dem Wandler zusammenwirkenden Endes des Armes übersetzt werden.

7. Vorrichtung nach Anspruch 4, 5 oder 6, dadurch gekennzeichnet, daß der Abtaster eine zylindrische Rolle ist, deren Achse an einem Ende des Armes befestigt ist.

8. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß der Wandler ein linear variabler Differentialtransformator ist.

9. Vorrichtung nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß der Abtaster (52) eine zylindrische Rolle ist und der Wandler (53) von dem mit variablen magnetischen Widerstand arbeitenden Typ ist und eine Spule aufweist, deren magnetischer Kreis durch einen Teil des Umfanges des Abtasters (52) vervollständigt wird, wobei das Dickensignal die Spannung (V_s) an der Wandlerspule ist und vom Grad der Verlagerung der Abtastrolle zum Kern des Wandlers hin abhängt.

10. Vorrichtung nach Anspruch 9, dadurch gekennzeichnet, daß die Stützfläche für das Blatt oder die Blätter von einer zweiten rolle (51) gebildet ist, welche zusammen mit der Abtastrolle einen Eintrittsspalt für das Blatt bzw. die Blätter bildet.

Revendications

1. Dispositif pour détecter le passage de feuilles simples et multiples le long d'un chemin de passage, comportant: une surface (6) dans le chemin de passage pour supporter la ou les feuilles; un palpeur (1) poussé de telle façon qu'il s'appuie normalement contre la surface support (6) et suive le profil de la surface support et de la ou des feuilles superposées; un transducteur (4, 53) sensible à la position du palpeur pour fournir un signal d'épaisseur (TP) indiquant le déplacement linéaire du palpeur par rapport à la surface support, déplacement provoqué par le passage de la ou des feuilles; et un circuit de contrôle comparant le signal d'épaisseur (TP) avec au moins un signal de niveau de seuil (TP1, TP2) pour fournir un signal de sortie (31, 32, 33) indiquant se l'épaisseur détectée correspond à celle d'une seule feuille ou de plusieurs feuilles; caractérisé par le fait que le circuit de contrôle comporte des moyens (9) sensibles audit signal d'épaisseur (TP)

pour remettre à jour de façon répétitive un niveau de référence sans feuille mis en mémoire en l'absence de feuille, et des moyens incluant des moyens adjustables (RV1, IC/3, TR8, R49, R52) pour produire un niveau de seuil adjustable pour produire un premier et un second signal qui coorespondent aux variations de la sortie du transducteur dûes au passage d'une simple feuille et de deux feuilles superposées, respectivement, et des moyens reliant les moyens produisant le premier et le second signal à la sortie des moyens (9) de mise à jour de façon à ajouter le signal de référence sans feuille mis à jour au premier et au second signal pour obtenir le premier et le second signal de niveau de seuil mis à jour, signaux qui seront dépassés par la sortie du transducteur en réponse au passage d'une seule feuille et de deux feuilles superposées, respectivement.

2. Dispositif selon la revendication 1, dans lequel les moyens pour produire lesdits premier et second signaux comportent une résistance variable pouvant être ajustée manuellement (RV1), une source de courant constant (IC3/3, TR8) dont la sortie est déterminée par la résistance variable, et une première et une seconde résistances de référence (R49, R52) branchées en série entre la sortie de la source de courant constant et la sortie des moyens de mise à jour (9).

3. Dispositif selon les revendications 1 ou 2, dans lequel le signal de référence sans feuille (TP3) mis en mémoire revêt la forme d'une tension continue stockée dans un condensateur (C13), le dispositif comportant des moyens (TR6) pour empêcher le condensateur de suivre ledit signal d'épaisseur (TP) chaque fois que le signal d'épaisseur diffère substantiellement de sa valeur en l'absence de feuille entre la surface support et le palpeur (1).

4. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le palpeur (1) est fixé à une extrémité d'un bras (2) dont l'autre extrémité s'engage dans le transducteur (4).

5. Dispositif selon la revendication 4, comportant un bras allongé pivotant en un point (3) placé sur sa longueur pour transmettre le mouvement du palpeur au transducteur.

6. Dispositif selon la revendication 5, dans lequel la position du pivot le long du bras est telle que de petits déplacements du palpeur sont transformés en des déplacements plus grands de l'autre extrémité du bras qui s'engage dans le transducteur.

7. Dispositif selon les revendications 4, 5 ou 6, dans lequel le palpeur est un rouleau cylindrique dont l'axe est fixé à une extrémité du bras.

8. Dispositif selon une quelconque des revendications précédentes dans lequel le transducteur est un transformateur différentiel variable linéaire.

9. Dispositif selon les revendications 1, 2 ou 3 dans lequel le palpeur (52) est un rouleau cylindrique et le transducteur (53) est du type à réluctance variable et comporte un transformateur dont le circuit magnétique est complété par une partie de la périphérie du palpeur (52), le signal d'épaisseur étant la tension (Vs) aux bornes du transformateur et dépendant du degré de déplacement du rouleau palpeur par rapport à un noyau du transformateur.

10. Dispositif selon la revendication 9, dans lequel la surface support pour la ou les feuilles est un second rouleau (51), lequel forme avec le palpeur une pince pour la ou les feuilles.

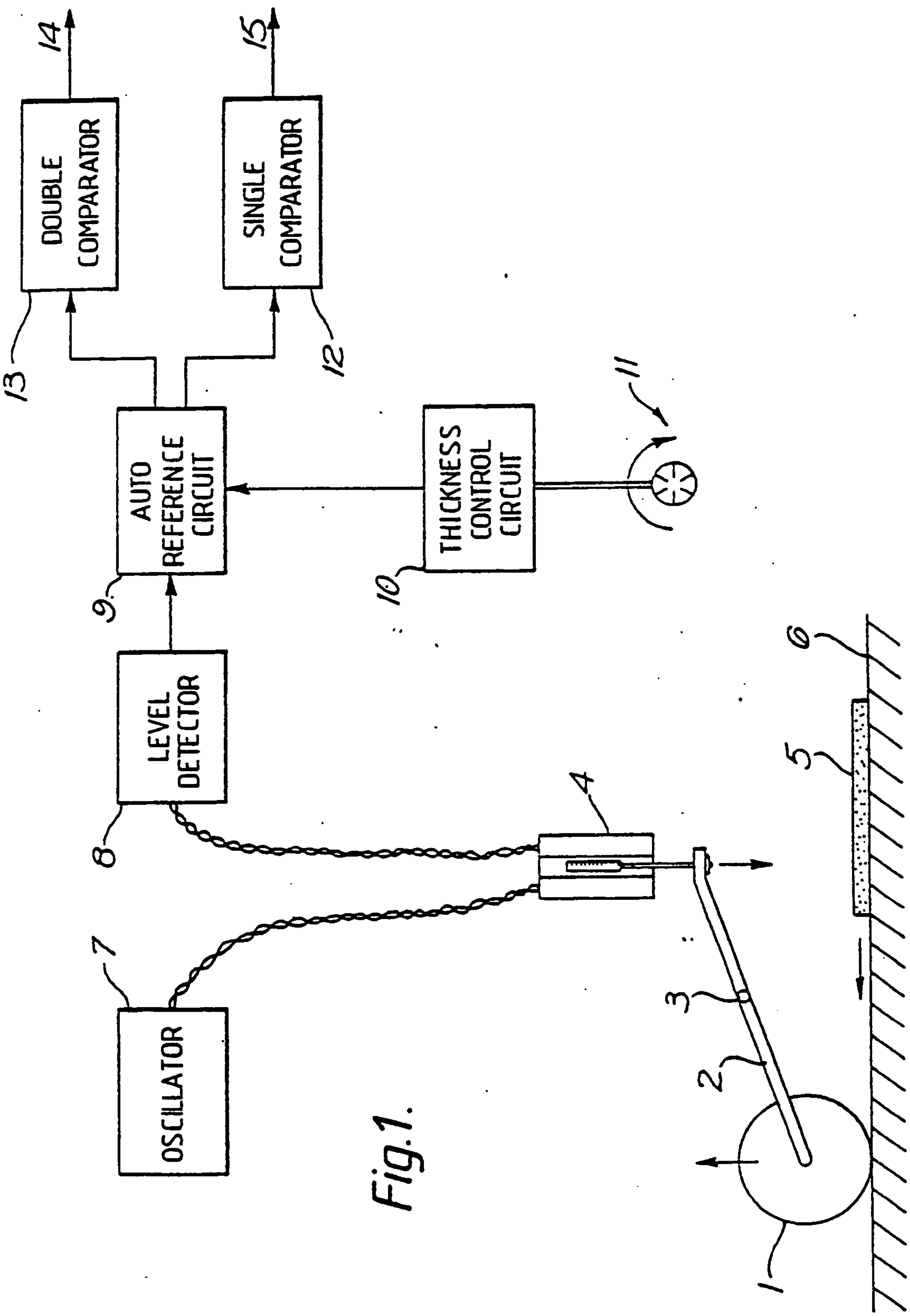
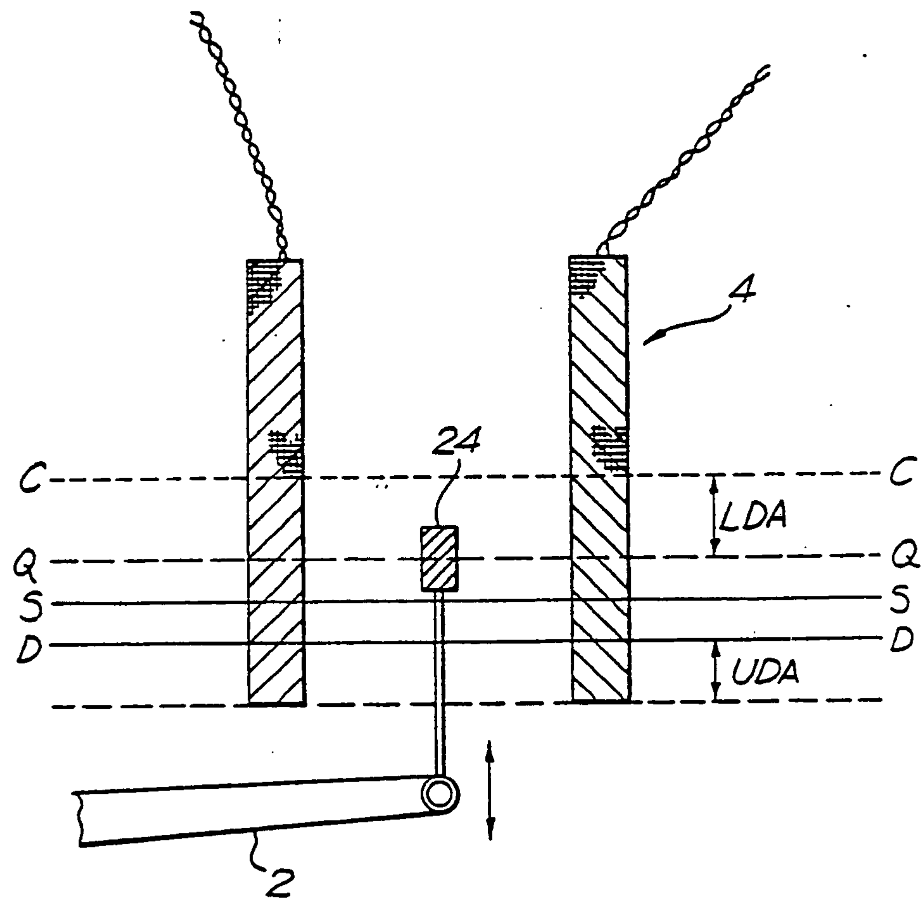

DOUBLE COMPARATOR
SINGLE COMPARATOR
AUTO REFERENCE CIRCUIT
THICKNESS CONTROL CIRCUIT
LEVEL DETECTOR
OSCILLATOR
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

Fig.1.

Fig.2.



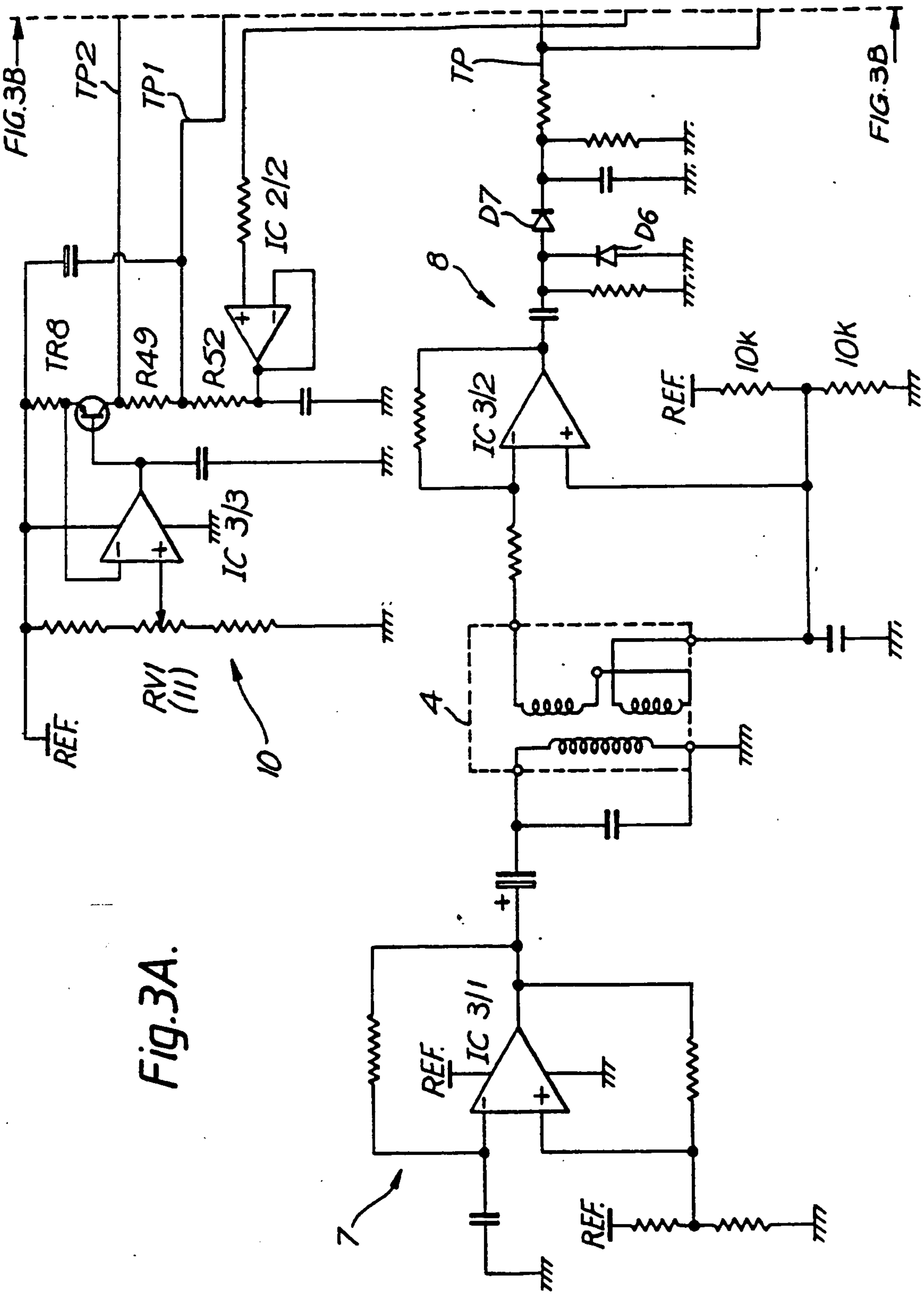


FIG.3B
TP2
TP1
IC 2/2
TR8
R49
R52
IC 3/3
RV1
(11)
REF.
10
8
TP
D7
D6
IC 3/2
REF.
10K
10K
4
IC 3/1
REF.
REF.
7
FIG.3B

Fig.3A.

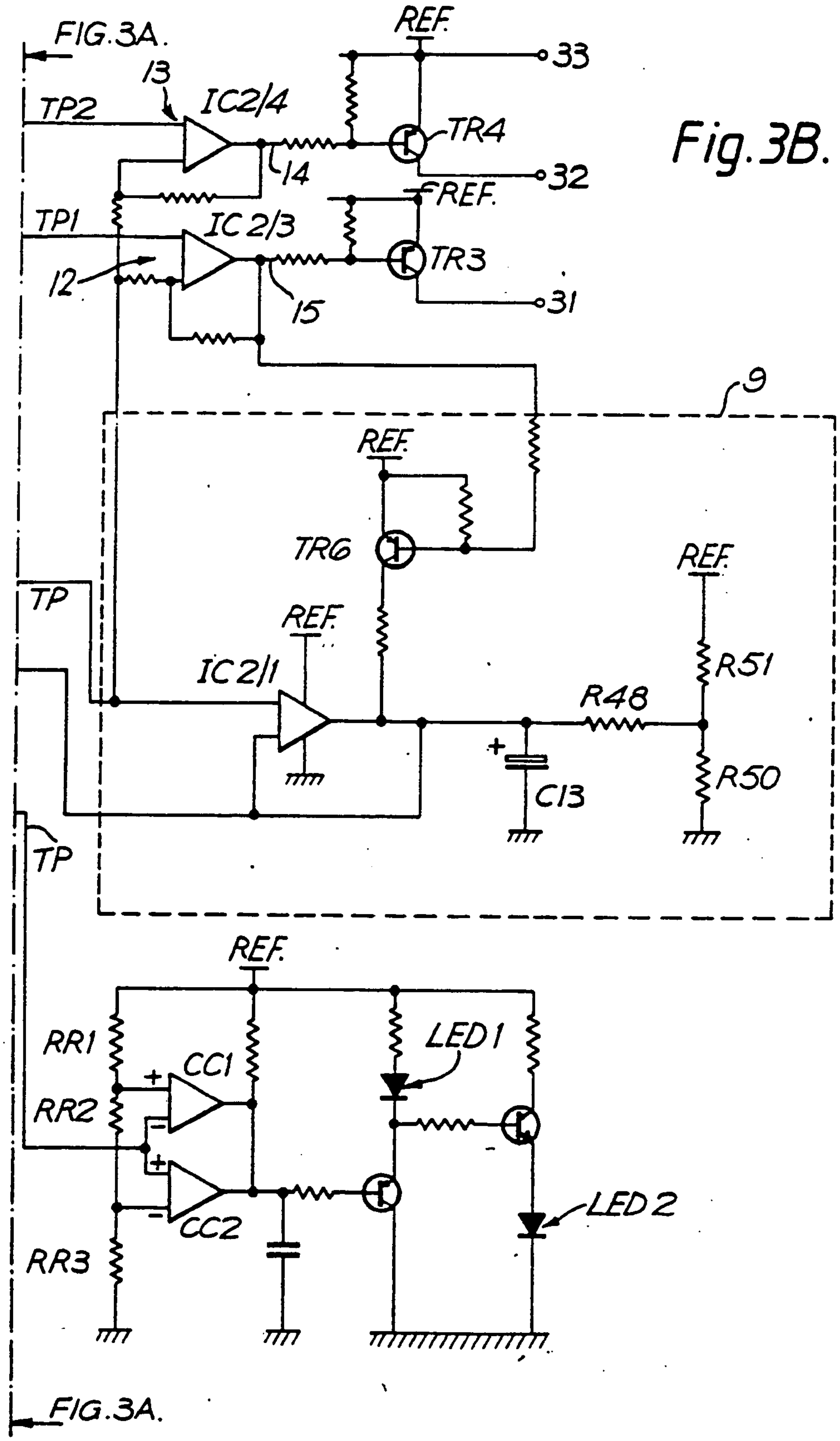
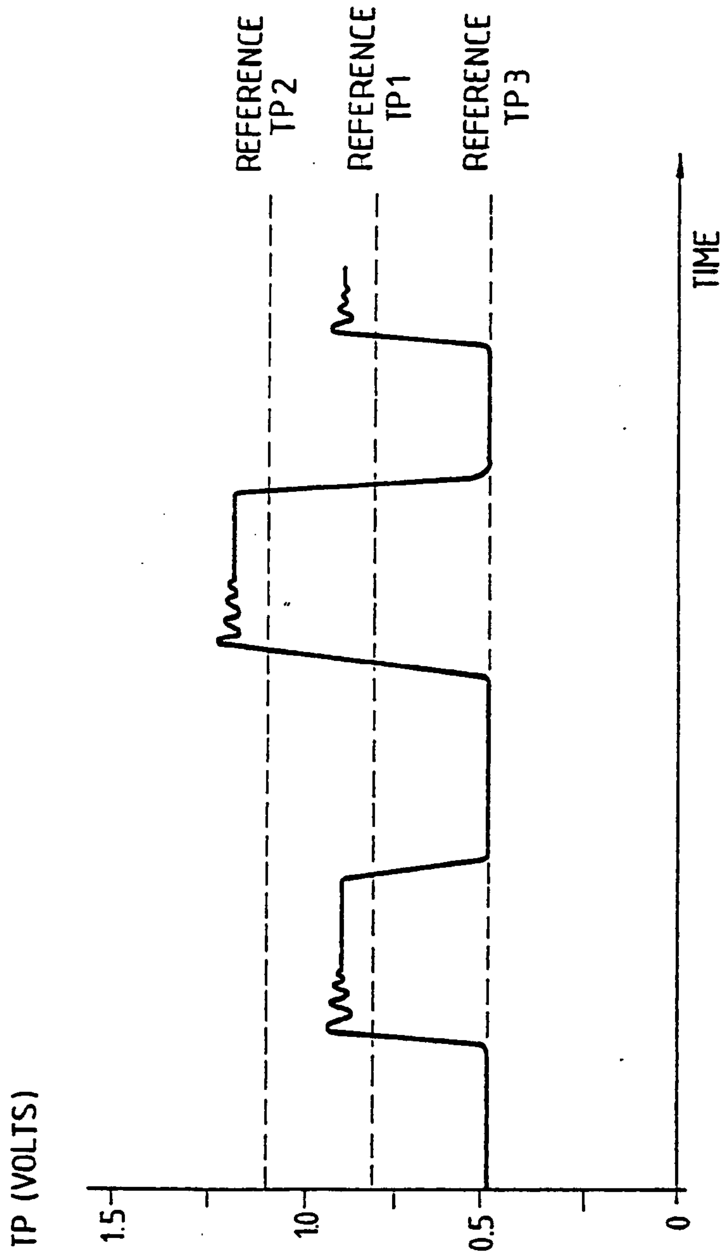


FIG.3A.
13
TP2
IC2/4
REF.
33
TR4
14
32
REF.
TP1
IC 2/3
TR3
12
15
31
9
REF.
TR6
REF.
TP
REF.
R51
IC 2/1
R48
+
C13
R50
TP
REF.
RR1
LED 1
CC1
+
RR2
-
+
-
LED 2
CC2
RR3
FIG.3A.

Fig.3B.

Fig.4.


TP (VOLTS)
1.5
1.0
0.5
0
REFERENCE TP2
REFERENCE TP1
REFERENCE TP3
TIME

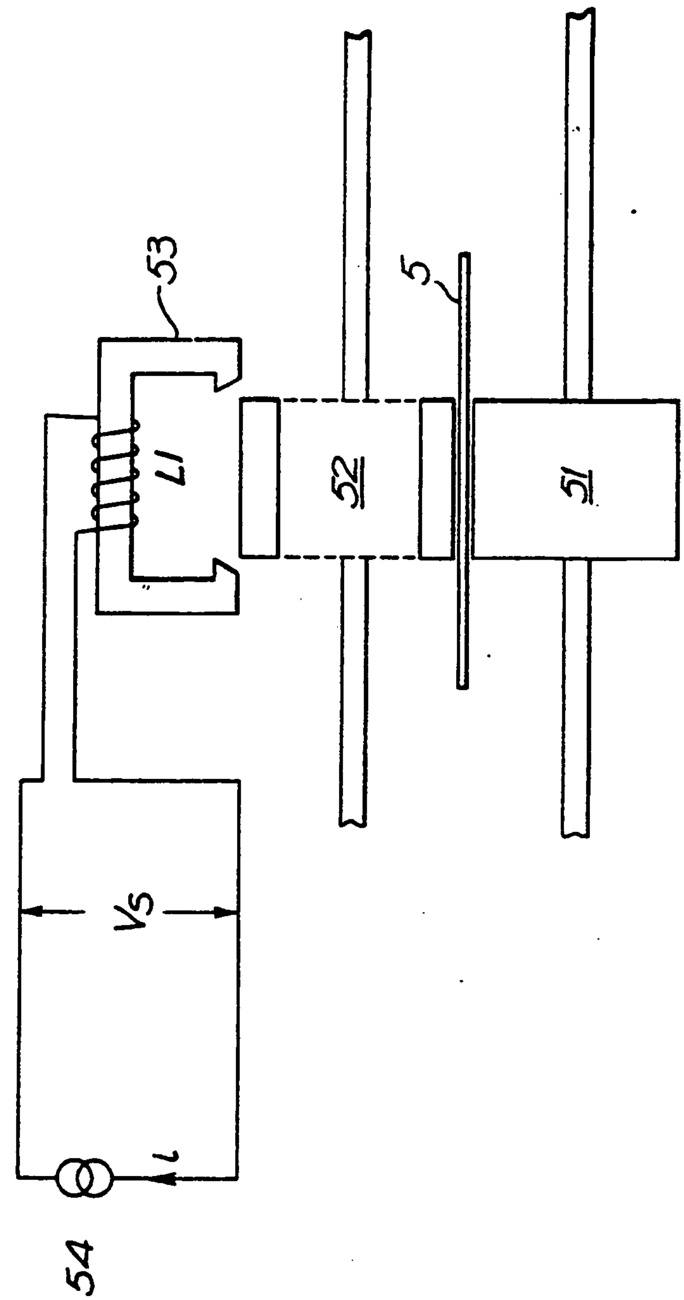


Fig.5.